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Title of the Invention : OPTICAL RECORDING MEDIUM

Translation of Column 1, lines 1 - 19

【Claims】

【Claim 1】

An optical recording medium utilizing energy of an electromagnetic wave to perform recording and erasure, comprising a recording layer containing, as its principal component, a compound having a composition expressed as:

Ga_xSe_{1-x}

where $0.15 \leq x \leq 0.8$ (atomic ratio).

【Claim 2】

The optical recording medium according to claim 1, wherein the recording layer satisfies a condition expressed as:

$kc \leq 1.1$; and

$ka \geq 0.7$

where kc represents a value of an amplitude extinction coefficient in the crystalline state, and ka represents a value of the same in the amorphous state, the amplitude extinction coefficient being an optical constant.

【Claim 3】

The optical recording medium according to claim 1 or 2, formed by successively laminating a lower heat-resistant protective layer, a recording layer, an upper heat-resistant protective layer, and a reflection layer on a substrate, wherein an optical film thickness d_1' ($= d_1 \times n_1$) that is determined according to a thickness d_1 and an index of refraction n_1 of the lower heat-resistant protective layer, and an optical film thickness d_2' ($= d_2 \times n_2$) that is determined according to a thickness d_2 and an index of refraction n_2

of the upper heat-resistant protective layer satisfy conditions expressed as:

$$500n_1 \leq d_1' \leq 500n_1 + 4700 \text{ [Å]}$$

$$500n_2 \leq d_2' \leq 500n_2 + 4250 \text{ [Å]}.$$

Translation of Column 2, line 44 - Column 3, line 23

【0008】

A recording layer of the present invention is made of, as its principal component, a material having a composition expressed as Ga_xSe_{1-x} where x satisfies $0.15 \leq x\ 0.8$ (atomic ratio). This recording layer may be formed by various gas-phase growing methods including vacuum vapor deposition, sputtering, plasma CVD, optical CVD, ion plating, electron beam vapor deposition, etc. Apart from the gas-phase growing methods, the wet processes such as the sol-gel method can be used. The recording layer has a thickness of 100 to 1200 Å, preferably, 200 to 1000 Å. In the case where the thickness is less than 100 Å, the light absorbing capability significantly decreases, and the recording layer cannot perform the function as the recording layer. In the case where the thickness is more than 1300 Å, it is impossible to achieve a disk configuration that provides a high reflectance and a high contrast. Furthermore, an energy band gap Eg of the recording layer preferably is not less than 1.0 eV. This wide energy gap allows the light transmittance to increase, thereby providing an increase in the reflectance by using optical interference. Furthermore, the value of the amplitude extinction coefficient in the crystalline state as an optical constant of the recording layer desirably is not more than 1.1, more preferably, not more than 0.2. The value of the same in the amorphous state desirably is not less than 0.7, more preferably, not less than 1.0. By satisfying these conditions to increase a difference between the extinction coefficients in the amorphous state and in the crystalline state, the optical interference can be utilized under appropriate conditions, and hence, a layer configuration in which the reflectance in the crystalline state is great and that in the amorphous state is small can be obtained, with which an appropriate contrast can be obtained. Furthermore, since generally the transition to the amorphous state tends to occur most at an average coordination number of 2.45, it is desirable to select an appropriate composition that provides an average coordination number close to the above, namely, 2.45±0.6. By so doing, the transition to the amorphous state

can be easily achieved, which allows a high contrast to be achieved.

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(71) Applicant: **RICOH CO LTD**

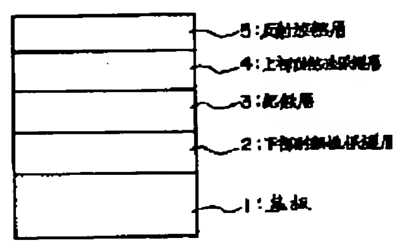
(72) Inventor: **HAYASHI YOSHITAKA**
HARIGAI MASATO
TAKAHASHI MASAYOSHI
IWASAKI HIROKO
IDE YUKIO

(54) OPTICAL RECORDING MEDIUM

(57) Abstract:

PURPOSE: To obtain an optical recording medium high in reflectivity and contrast and enabling the many-time repetition of recording-erasure by low power by providing a recording layer based on a specific GaSe compsn. and utilizing energy of an electromagnetic wave to perform recording and erasure.

CONSTITUTION: A lower heat-resistant protective layer 2, a recording layer 3, an upper heat-resistant protective layer 4 and a reflecting layer 5 are provided on a substrate and recording and erasure are performed by utilizing an electromagnetic wave. The recording layer 3 is constituted based on a compsn. represented by Ga_xSe_{1-x} [wherein x is 0.15-0.8 (atom ratio)] and can be formed by a vacuum vapor deposition method, a sputtering method, a plasma CVD method, an ion plating method or an electron beam vapor deposition method and the thickness thereof is pref. set to 200-100Å.



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(71)出願人　000006747
株式会社リコー
東京都大田区中馬込1丁目3番6号

(72)発明者　林　嘉隆
東京都大田区中馬込1丁目3番6号　株式会社リコー内

(72)発明者　針谷　眞人
東京都大田区中馬込1丁目3番6号　株式会社リコー内

(72)発明者　高橋　正悦
東京都大田区中馬込1丁目3番6号　株式会社リコー内

(74)代理人　弁理士　池浦　敏明　（外1名）

最終頁に続く

(54)【発明の名称】　光記録媒体

(57)【要約】

【目的】　反射率、コントラストが高く、低パワーで記録－消去の多数回繰り返しが可能な書き替え可能な相変化形光記録媒体を提供する。

【構成】　電磁波のエネルギーを利用して記録消去を行う光記録媒体において、Ga_xSe_{1-x}（但し、0．15≦x≦0．8（原子比））で表わされる組成物を主成分とする記録層を有することを特徴とする光記録媒体。

【特許請求の範囲】

【請求項1】 電磁波のエネルギーを利用して記録消去を行う光記録媒体において、Ga_xSe_{1-x}（但し、0．15≦x≦0．8（原子比））で表わされる組成物を主成分とする記録層を有することを特徴とする光記録媒体。

【請求項2】 前記記録層が、光学定数である振幅消衰係数の結晶層の値をkc、アモルファス相の値をkaとしたとき、kc≦1．1かつka≧0．7なる条件を満足することを特徴とする請求項1に記載の光記録媒体。

【請求項3】 基板上に下部耐熱性保護層、記録層、上部耐熱性保護層及び反射層を順次積層してなり、前記下部耐熱性保護層の膜厚d_1、屈折率n_1から求められる光学的膜厚d_1'（$=d_1\times n_1$）及び前記上部耐熱性保護層の膜厚d_2、屈折率n_2から求められる光学的膜厚d_2'（$=d_2\times n_2$）が、下記条件を満足することを特徴とする請求項1又は2に記載の光記録媒体。

$500n_1 \leq d_1' \leq 500n_1+4700$〔Å〕

$500n_2 \leq d_2' \leq 500n_2+4250$〔Å〕

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は光記録媒体、特に光ビームを照射することにより記録層材料に相変化を生じさせ、情報の記録、再生を行い、かつ書き換えが可能である相変化形光記録媒体に関するものであり、コンパクトディスク関連機器に応用される。

【0002】

【従来の技術】電磁波、特にレーザービームの照射による情報の記録、再生および消去可能な光メモリー媒体の一つとして、結晶－非結晶相間、あるいは結晶－結晶相間の転移を利用する、いわゆる相変化形光記録媒体がよく知られている。この相変化形光記録媒体は、特に光磁気メモリーでも困難な単一ビームによるオーバーライトが可能であり、ドライブ側の光学系よりも単純であることなどから、最近その研究開発が活発になっている。特に同一の光学系を用いることができるという利点から、高反射率、高コントラストといった特性をあわせて持った、書き換えのできるコンパクトディスク（CD）としての応用が期待されている。

【0003】相変化形光記録材料の代表的な例として、USP3530441に開示されているように、Ge－Te、Ge－Te－Sn、Ge－Te－S、Ge－Se－S、Ge－Se－Sb、Ge－As－Se、In－Te、Se－Te、Se－Asなどのいわゆるカルコゲン系合金材料があげられる。また安定性、高速結晶化などの向上を目的に、Ge－Te系にAu（特開昭61－219692号公報）、SnおよびAu（特開昭61－270190号公報）、Pb（特開昭62－19490号公報）などを添加した材料の提案や、記録／消去の繰り返し性能向上を目的にGe－Te－Se－Sb、Ge－Te－Sbの組成比を特定した材料（特開昭62－73438号公報、特開昭63－228433号公報）の提案などもなされている。

【0004】しかしながら、そのいずれも、元来コードデータファイル用の書き換え可能光ディスクとして設計されており、書き替え可能な相変化形コンパクトディスクとして要求される諸特性のほとんどを満足できていないのが現状である。特に反射率、コントラスト、記録感度が解決が解決すべき最重要課題となっている。これらの事情から反射率、コントラストが高く、高感度の記録、消去に適する記録材料の開発が望まれていた。

【0005】

【発明が解決しようとする課題】本発明は、以上のような事情に鑑みてなされたものであり、反射率、コントラストが高く、低パワーで記録－消去の多数回繰り返しが可能な書き換え可能な相変化形光記録媒体を提供することを目的とする。

【0006】

【課題を解決するための手段】上記目的を達成するため、本発明によれば、電磁波のエネルギーを利用して記録消去を行う光記録媒体において、Ga_xSe_{1-x}（但し、0．15≦x≦0．8（原子比））で表わされる組成物を主成分とする記録層を有することを特徴とする光記録媒体が提供される。また、本発明によれば、上記構成において、前記記録層が、光学定数である振幅消衰係数の結晶層の値をkc、アモルファス相の値をkaとしたとき、kc≦1．1かつka≧0．7なる条件を満足することを特徴とする光記録媒体が提供される。さらに、本発明によれば上記構成において、基板上に下部耐熱性保護層、記録層、上部耐熱性保護層及び反射層を順次積層してなり、前記下部耐熱性保護層の膜厚d_1、屈折率n_1から求められる光学的膜厚d_1'（$=d_1\times n_1$）及び前記上部耐熱性保護層の膜厚d_2、屈折率n_2から求められる光学的膜厚d_2'（$=d_2\times n_2$）が、下記条件を満足することを特徴とする光記録媒体が提供される。

$500n_1 \leq d_1' \leq 500n_1+4700$〔Å〕

$500n_2 \leq d_2' \leq 500n_2+4250$〔Å〕

【0007】以下本発明を添付図面に基づき説明する。図1は本発明の構成例を示すものである。基板1上に下部耐熱性保護層2、記録層3、上部耐熱性保護層4、反射層5が設けられている。もちろん、本発明はこの構成例のみに限定されるものではなく、反射層5の上に環境保護層を設ける等、種々の変形、変更が可能である。

【0008】本発明の記録層は、Ga_xSe_{1-x}（但し、0．15≦x≦0．8（原子比））で表わされる組成物を主成分として構成される。この記録層は各種気相成長法、たとえば真空蒸着法、スパッタリング法、プラズマCVD法、光CVD法、イオンプレーティング法、電子ビーム蒸着法などによって形成できる。気相成長法以外のゾルーゲル法のような湿式プロセスも適用可能であ

る。記録層の膜厚としては１００～１２００Å、好適には２００～１０００Åとするのがよい。記録層の膜厚が１００Åより薄いと光吸収能が著しく低下し、記録層としての役割をはたさなくなる。また１３００Åより厚いと反射率、コントラストが高いディスク構成がとれなくなる。また、記録層のエネルギーバンドギャップE_gは１．０ｅＶ以上であることが望ましい。このエネルギーギャップが広いことで光の透過率が上がり、光学干渉を利用することにより反射率を高くすることが可能となる。また、記録層において光学定数である振幅消衰係数の結晶相の値ｋｃは１．１以下、好ましくは０．２以下であるのが望ましく、アモルファス層の値ｋａは０．７以上、好ましくは１．０以上であるのが望ましい。これらの条件を満たし、アモルファス相と結晶相の消衰係数の値の差を大きくすることで光学干渉を適当な条件で利用でき、結晶相の反射率が大きく、アモルファス相の反射率が小さい層構成で適当なコントラストを得ることが可能である。また、一般に平均配位数２．４５で最もアモルファス化が起きやすいため、この値に近い配位数、すなわち２．４５±０．６の配位数を取るように適当な組成を選択することが望ましく、このようにすると、アモルファス化しやすくなり、それにともない高いコントラストが得られる。

【０００９】下部及び上部の耐熱性保護層は各種気相成長法、たとえば真空蒸着法、スパッタリング法、プラズ＊＊マＣＶＤ法、光ＣＶＤ法、イオンプレーティング法、電子ビーム蒸着法などによって形成できる。また、必要に応じて不純物を含んでいてもよい。但し耐熱性保護層の融点は記録層の融点よりも高いことが必要である。

【００１０】下部耐熱性保護層の果たす主な役割として、耐熱性を確保する効果と、干渉を利用し入射光・反射光を効率的に利用する光学的効果とがある。下部耐熱性保護層の材料としては、例えばＺｎＳとSiO_2の混合物等を用いることができるが、これに限定されない。また、上部耐熱性保護層は反射層へ熱を逃がす役割等を行う。上部耐熱性保護層の材料としては、例えば窒化アルミニウム、ＺｎＳとSiO_2の混合物等を用いることができるが、これに限定されない。耐熱性の観点から言えば、薄すぎる耐熱性保護層では隣接する基板および層に過剰な熱が伝わる。このため、例えば、下部耐熱性保護層として主にＺｎＳとSiO_2の混合物からなる層を用いたとき、最小膜厚は５００Å、上部耐熱性保護層として主に窒化アルミニウム、またはＺｎＳとSiO_2の混合物からなる層を用いたときは５０Å以上でなければその機能をはたせなくなる。

【００１１】また、光学的観点から言えば、使用する電磁波の波長をλ、耐熱性保護層の屈折率をｎとすれば、膜厚がλ／４ｎ毎の周期で同一の光学的条件が現われる。従って、最適な最小膜厚を仮に$d_0 \cdot n$とすると、

$$d_0+m\cdot(\lambda/4n)\quad(m=1,2,3...)\cdots\cdots(\mathrm{I})$$

に従って最適条件が得られる。しかし、耐熱性保護層が厚すぎると界面の剥離や、ひずみを起こしやすくなる。特に上部耐熱性保護層は反射層へと熱を逃がす役割を担うため、これが厚すぎると記録層に余剰な熱が蓄積され、ディスクとしての記録消去特性が劣化し、層分離や物質移動等を引き起こすので好ましくない。これらの事情から、式（Ｉ）中のｍは下部耐熱性保護層は２、上部耐熱性保護層は１が最適膜厚となる。本発明の光記録媒体は書き換えのできるコンパクトディスクに関するものであるから、波長７６０～８４０ｎｍでの$m\cdot(\lambda/4n)$を考えればよい。従って、下部耐熱性保護層の膜厚をd_1、屈折率をn_1としたとき、その光学的膜厚d_1'（$=d_1\times n_1$）は下記条件を満足することが望ましい。

$$500n_1\leq d_1'\leq 500n_1+4700\ [\text{Å}]$$

また、上部耐熱性保護層の膜厚をd_2、屈折率をn_2としたとき、その光学的膜厚d_2'（$=d_2\times n_2$）は下記条件を満足することが望ましい。

$$50n_2\leq d_2'\leq 50n_2+4250\ [\text{Å}]$$

【００１２】基板の材料は通常、樹脂、ガラス、あるいはセラミックスであり、樹脂基板が成形性、コストの点で好適である。樹脂の代表例としてはポリカーボネート樹脂、アクリル樹脂、エポキシ樹脂、ポリスチレン樹脂、アクリロニトリルースチレン共重合体樹脂、ポリエチレン樹脂、ポリプロピリン樹脂、シリコーン系樹脂、フッ素系樹脂、ＡＢＳ樹脂、ウレタン樹脂などがあげられるが、加工性、光学特性などの点でポリカーボネート樹脂、アクリル系樹脂が好ましい。

【００１３】反射層としては、Ａｌ、Ａｕ、Ａｇなどの金属材料、またまそれらの合金などを用いることができる。このような反射層は各種気相成長法、たとえば真空蒸着法、スパッタリング法、プラズマＣＶＤ法、光ＣＶＤ法、イオンプレーティング法、電子ビーム蒸着法などによって形成できる。

【００１４】また、本発明の光記録媒体は、使用電磁波の波長が７６０～８４０ｍｍのとき未記録部の反射部は７０％以上、記録部と未記録部はコントラストが６０％以上であるのが好ましい。

【００１５】さらに、本発明の光記録媒体を用いて記録、消去、再生をする場合、光記録媒体と電磁波ビームスポットとの相対速度は、コンパクトディスクの再生時の線速、即ち、１．２ｍ／ｓ以上１．４ｍ／ｓ以下と同等か、又はその整数倍であることが望ましい。

【００１６】

【実施例】以下、実施例によって本発明を具体的に説明するが、この実施例は本発明をなんら制限するものではない。

【００１７】〔実施例１〕１２０ｍｍφのグルーブ付きポリカーボネート基板上にＺｎＳ・SiO_2（７００

Å）、$Ga_{0.5}Se_{0.5}$（８７０Å）、窒化アルミニウム（１１００Å）、Ａｇ（７００）を順次スパッタ法にて積層し、その上に紫外線硬化樹脂を塗布し、光ディスクを作製した。$Ga_{0.5}Se_{0.5}$の光学定数は記録部でｎ＝２．２９７、ｋ＝０．７５８、未記録部でｎ＝１．７５５、ｋ＝０．１４２であった。ZnS・SiO_2層の光学定数はｎ＝２．０、ｋ≒０であった。また、このディスク構成で得られるミラー部（グルーブのない部分）での反射率とコントラストの上部、下部それぞれの耐熱性保護層膜厚依存性を、別途、シュミレーションにより求めた。その結果を図２、図３に示す。上部耐熱性保護層膜厚及び下部耐熱性保護層膜厚は、図２、図３の結果に基づき上記値に設定したものである。

【００１８】上記ディスク線速１．２ｍ／ｓ、再生光パワー１．０ｍＷ、半導体レーザー波長７８０ｎｍ、対物レンズＮＡ＝０．５条件下で、反射率が飽和するまで初期化した。これにより、反射率７０％を得た。オーバーライトモードにおける記録パワー、消去パワーとＣＮＲ、消去比、記録前と後の反射率から計算されるコントラストを調べたところ、十分なＣＮＲと消去比が得られ＊るパワー領域で十分なコントラストが得られていることがわった。

【００１９】

【発明の効果】本発明によれば、前記構成としたので、反射率、コントラストの飛躍的向上を達成する相変化形光記録媒体を提供することが可能となる。

【図面の簡単な説明】

【図１】本発明による光記録媒体の構成例を接式的に示す断面図である。

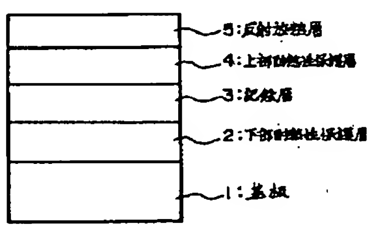
【図２】反射率、コントラストの上部耐熱性保護層膜厚依存性を示す図である。

【図３】反射率、コントラストの下部耐熱性保護層膜厚依存性を示す図である。

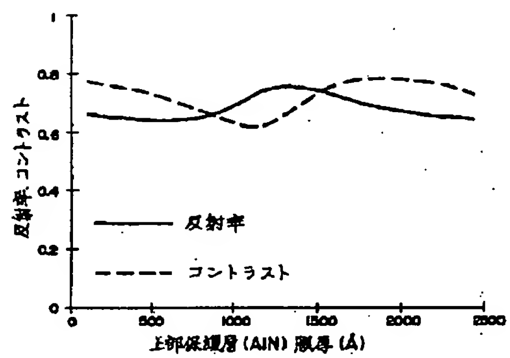
【符号の説明】

1　基板
2　下部耐熱性保護層
3　記録層
4　上部耐熱性保護層
5　反射層

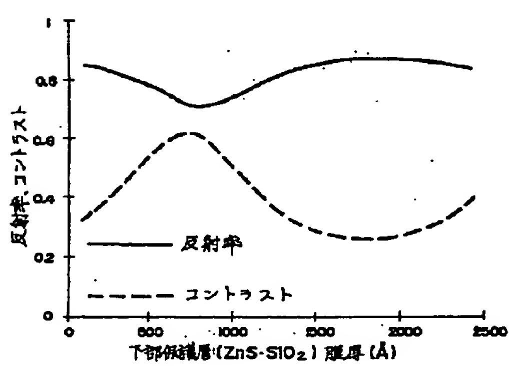
【図１】



【図２】



【図３】



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(72)発明者　岩崎　博子
東京都大田区中馬込１丁目３番６号　株式会社リコー内

(72)発明者　井手　由紀雄
東京都大田区中馬込１丁目３番６号　株式会社リコー内

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(71)Applicant : RICOH CO LTD

(72)Inventor : HAYASHI YOSHITAKA
HARIGAI MASATO
TAKAHASHI MASAYOSHI
IWASAKI HIROKO
IDE YUKIO

(54) OPTICAL RECORDING MEDIUM

(57)Abstract:

PURPOSE: To obtain an optical recording medium high in reflectivity and contrast and enabling the many-time repetition of recording-erasure by low power by providing a recording layer based on a specific GaSe compsn. and utilizing energy of an electromagnetic wave to perform recording and erasure.

CONSTITUTION: A lower heat-resistant protective layer 2, a recording layer 3, an upper heat-resistant protective layer 4 and a reflecting layer 5 are provided on a substrate and recording and erasure are performed by utilizing an electromagnetic wave. The recording layer 3 is constituted based on a compsn. represented by GaxSe1-x [wherein x is 0.15-0.8 (atom ratio)] and can be formed by a vacuum vapor deposition method, a sputtering method, a plasma CVD method, an ion plating method or an electron beam vapor deposition method and the thickness thereof is pref. set to 200-100Å.

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CLAIMS

[Claim(s)]
[Claim 1] The optical recording medium characterized by having the record layer which uses as a principal component the constituent expressed with GaxSe1-X (however, 0.15<=x<=0.8 (atomic ratio)) in the optical recording medium which performs record elimination using the energy of an electromagnetic wave.
[Claim 2] The optical recording medium according to claim 1 characterized by satisfying kc<=1.1 and the conditions which become ka>=0.7 when said record layer sets the value of kc and an amorphous phase to ka for the value of the crystal layer of the amplitude extinction coefficient which is an optical constant.
[Claim 3] It comes to carry out the laminating of a lower thermal-resistance protective layer, a record layer, an up thermal-resistance protective layer, and the reflecting layer one by one on a substrate. Optical thickness d2' (=d2xn2) called for from the thickness d2 of optical thickness d1' (=d1xn1) called for from the thickness d1 of said lower thermal-resistance protective layer and a refractive index n1 and said up thermal-resistance protective layer and a refractive index n2 The optical recording medium according to claim 1 or 2 characterized by satisfying the following conditions.
500n1<=d1'<=500n1+4700[**]
500n2<=d2'<=500n2+4250[**]

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] By irradiating an optical recording medium, especially a light beam, this invention makes a record layer ingredient produce a phase change, and is applied to a compact disk related equipment about the phase change form optical recording medium which can perform informational record and playback and can be rewritten.
[0002]
[Description of the Prior Art] The so-called phase change form optical recording medium using transition between a crystal-amorphous interphase or a crystal-crystal phase is well known as one of the optical-memory media in which record of an electromagnetic wave, especially the information by the exposure of a laser beam, playback, and elimination are possible. Since over-writing by the difficult single beam is especially possible for this phase change form optical recording medium also by optical MAG memory and it is simpler than the optical system by the side of a drive, that researches and developments are active recently. From the advantage that the same optical system can be used especially, the application as a compact disk (CD) whose rewriting is possible which it had in accordance with properties, such as a high reflection factor and high contrast, is expected.
[0003] As a typical example of phase change form material for optical recording, the so-called chalcogen system alloy ingredients, such as germanium-Te, germanium-Te-Sn, germanium-Te-S, germanium-Se-S, germanium-Se-Sb, germanium-As-Se, In-Te, Se-Te, and Se-As, are raised as indicated by USP3530441. Moreover, the proposal of the ingredient which added Au (JP,61-219692,A), Sn, Au (JP,61-270190,A), Pb (JP,62-19490,A), etc. in the germanium-Te system, the proposal of an ingredient (JP,62-73438,A, JP,63-228433,A) which specified the presentation ratio of germanium-Te-Se-Sb and germanium-Te-Sb for the purpose of the improvement in repeatability ability of record/elimination are made for the purpose of the improvement in stability, high-speed crystallization, etc.
[0004] However, the all are originally designed as a rewritable optical disc for code data files, and the present condition is that many properties of most demanded as a rewritable phase change form compact disk are unsatisfying. A reflection factor, contrast, and record sensibility serve as a problem of the utmost importance which solution should solve especially. A reflection factor and contrast were high from these situations, and record of high sensitivity and development of the record ingredient suitable for elimination were desired.
[0005]
[Problem(s) to be Solved by the Invention] This invention is made in view of the above situations, and a reflection factor and contrast are high and it aims at offering the phase change form optical recording medium in which rewriting in which the many times repeat of record-elimination is possible is possible by low power.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, according to this invention, in the optical recording medium which performs record elimination using the energy of an

electromagnetic wave, the optical recording medium characterized by having the record layer which uses as a principal component the constituent expressed with GaxSe1-X (however, 0.15<=x<=0.8 (atomic ratio)) is offered. Moreover, when said record layer sets the value of kc and an amorphous phase to ka for the value of the crystal layer of the amplitude extinction coefficient which is an optical constant in the above-mentioned configuration according to this invention, the optical recording medium characterized by satisfying kc<=1.1 and the conditions which become ka>=0.7 is offered. According to this invention, it sets in the above-mentioned configuration. On a substrate Furthermore, a lower thermal-resistance protective layer, Optical thickness d2' (=d2xn2) called for from the thickness d2 of optical thickness d1' (=d1xn1) which comes to carry out the laminating of a record layer, an up thermal-resistance protective layer, and the reflecting layer one by one, and is called for from the thickness d1 of said lower thermal-resistance protective layer and a refractive index n1, and said up thermal-resistance protective layer, and a refractive index n2 The optical recording medium characterized by satisfying the following conditions is offered.
500n1<=d1'<=500n1+4700[**]
500n2<=d2'<=500n2+4250[**]
[0007] This invention is explained based on an accompanying drawing below. Drawing 1 shows the example of a configuration of this invention. The lower thermal-resistance protective layer 2, the record layer 3, the up thermal-resistance protective layer 4, and the reflecting layer 5 are formed on the substrate 1. Of course, various deformation, such as not being limited only to this example of a configuration and preparing a environmental protection layer on a reflecting layer 5, and modification are possible for this invention.
[0008] The record layer of this invention is constituted considering the constituent expressed with GaxSe1-X (however, 0.15<=x<=0.8 (atomic ratio)) as a principal component. This record layer can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc. A wet process like sol-gel methods other than vapor growth is also applicable. As thickness of a record layer, it is good to consider [100-1200A] as 200-1000A suitably. When the thickness of a record layer is thinner than 100A, light absorption ability falls remarkably and stops playing a role of a record layer. When thicker than 1300A, it becomes impossible moreover, to take a disk configuration with high reflection factor and contrast. Moreover, as for the energy band gap Eg of a record layer, it is desirable that it is 1.0eV or more. The permeability of light goes up by this energy gap being large, and it becomes possible by using optical interference to make a reflection factor high. Moreover, in a record layer, as for the value kc of the crystal phase of the amplitude extinction coefficient which is an optical constant, it is [1.1 or less] preferably desirable that it is 0.2 or less, and, as for the value ka of an amorphous layer, it is [0.7 or more] preferably desirable that it is 1.0 or more. These conditions are fulfilled, optical interference can be used on suitable conditions by enlarging the difference of the value of the extinction coefficient of an amorphous phase and a crystal phase, the reflection factor of a crystal phase is large, and it is possible to acquire suitable contrast by lamination with the small reflection factor of an amorphous phase. Moreover, if it is desirable to choose a suitable presentation so that the coordination number near this value, i.e., the coordination number of 2.45**0.6, may be taken and it does in this way in order that amorphous-ization may generally tend to break out with the average coordination number 2.45, it will become easy to make it amorphous and high contrast will be acquired in connection with it.
[0009] The heat-resistant protective layer of the lower part and the upper part can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc. Moreover, the impurity may be included if needed. However, the melting point of a heat-resistant protective layer needs to be higher than the melting point of a record layer.
[0010] As main roles which a lower thermal-resistance protective layer plays, there are effectiveness of securing thermal resistance, and optical effectiveness of using interference and using incident light and the reflected light efficiently. As an ingredient of a lower thermal-resistance protective layer, although

the mixture of ZnS and SiO2 etc. can be used, for example, it is not limited to this. Moreover, an up thermal-resistance protective layer performs the role which misses heat to a reflecting layer. As an ingredient of an up thermal-resistance protective layer, although alumimium nitride, the mixture of ZnS and SiO2, etc. can be used, for example, it is not limited to this. If it says from a heat-resistant viewpoint, in a too thin heat-resistant protective layer, superfluous heat will get across to the adjoining substrate and layer. If it is not 50A or more when the layer which the minimum thickness mainly becomes from alumimium nitride or the mixture of ZnS and SiO2 as 500A and an up thermal-resistance protective layer when the layer which mainly consists of mixture of ZnS and SiO2 as a lower thermal-resistance protective layer is used for example, is used, it will become impossible for this reason, to achieve that function.
[0011] Moreover, if it says from an optical viewpoint, the optical conditions that n, then thickness are the same with the period in every lambda/4n will appear the refractive index of lambda and a heat-resistant protective layer in the wavelength of the electromagnetic wave to be used. Therefore, if the optimal minimum thickness is set to d0andn, it is. d0+m- (lambda/4n) (m= 1, 2, 3 ...) .... (I)
It is alike, and it follows and optimum conditions are acquired. However, if a heat-resistant protective layer is too thick, it will lifting-come to be easy of exfoliation of an interface, and a strain. Since it bears the role which misses heat to a reflecting layer, and surplus heat will be accumulated in a record layer, the record elimination property as a disk will deteriorate and it will cause layer separation, mass transfer, etc. if especially an up thermal-resistance protective layer has this too thick, it is not desirable. As for 2 and an up thermal-resistance protective layer, as for a lower thermal-resistance protective layer, 1 serves as [m in a formula (I)] the optimal thickness from these situations. Since the optical recording medium of this invention is related with the compact disk whose rewriting is possible, it should just consider m-(lambda/4n) with a wavelength of 760-840nm. Therefore, when thickness of a lower thermal-resistance protective layer is set to d1 and a refractive index is set to n1, as for the optical thickness d1' (=d1xn1), it is desirable to satisfy the following conditions.
500n1<=d1'<=500n1+4700[**]
Moreover, when thickness of an up thermal-resistance protective layer is set to d2 and a refractive index is set to n2, as for the optical thickness d2' (=d2xn2), it is desirable to satisfy the following conditions.
50n2<=d2'<=50n2+4250[**]
[0012] The ingredient of a substrate is resin, glass, or the ceramics, and a resin substrate is usually suitable for it in respect of a moldability and cost. Although polycarbonate resin, acrylic resin, an epoxy resin, polystyrene resin, acrylonitrile styrene copolymer resin, polyethylene resin, polypropylene pilin resin, silicone system resin, fluorine system resin, ABS plastics, urethane resin, etc. are raised as an example of representation of resin, polycarbonate resin and acrylic resin are desirable in respect of workability, an optical property, etc.
[0013] As a reflecting layer, metallic materials, such as aluminum, Au, and Ag, the alloy of ********, etc. can be used. Such a reflecting layer can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc.
[0014] Moreover, when the wavelength of a use electromagnetic wave of the optical recording medium of this invention is 760-840mm, as for the Records Department and the non-Records Department, it is desirable [the reflective section of the sheep Records Department] that contrast is 60% or more 70% or more.
[0015] Furthermore, when carrying out record, elimination, and playback using the optical recording medium of this invention, the relative velocity of an optical recording medium and the electromagnetic wave beam spot is equivalent in the less than linear velocity/[s and] at the time of playback of a compact disk, 1.2 or more m/s i.e., 1.4m, or it is desirable that it is the integral multiple.
[0016]
[Example] Hereafter, although an example explains this invention concretely, this example does not restrict this invention at all.
[0017] [Example 1] The laminating of ZnS-SiO2 (700A), Ga0.5Se0.5 (870A), alumimium nitride

(1100A), and Ag (700) was carried out in the spatter one by one on the polycarbonate substrate with a groove of 120mmphi, ultraviolet-rays hardening resin was applied on it, and the optical disk was produced. The optical constants of Ga0.5Se0.5 were n= 1.755 and k= 0.142 at the Records Department at n= 2.297, k= 0.758, and the non-Records Department. ZnS-SiO two-layer optical constants were n= 2.0 and k**0. Moreover, the heat-resistant protection layer membrane thickness dependency of the reflection factor in the mirror section (part without a group) obtained by this disk configuration, the upper part of contrast, and each lower part was separately searched for by the simulation. The result is shown in drawing 2 and drawing 3 . Up thermal-resistance protection layer membrane thickness and lower thermal-resistance protection layer membrane thickness are set as the above-mentioned value based on the result of drawing 2 and drawing 3 .

[0018] Under above-mentioned disk linear velocity 1.2 m/s and playback light power 1.0mW, the semiconductor laser wavelength of 780nm, and objective lens NA=0.5 conditions, it initialized until the reflection factor was saturated. This obtained 70% of reflection factors. When the record power in an exaggerated write mode, elimination power, CNR, an elimination ratio, and the contrast calculated from the reflection factor of record before and the back were investigated, that sufficient contrast is acquired broke by the power field in which sufficient CNR and a sufficient elimination ratio are obtained.

[0019]

[Effect of the Invention] According to this invention, since it considered as said configuration, it becomes possible to offer a reflection factor and the phase change form optical recording medium which attains the improvement in fast of contrast.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] By irradiating an optical recording medium, especially a light beam, this invention makes a record layer ingredient produce a phase change, and is applied to a compact disk related equipment about the phase change form optical recording medium which can perform informational record and playback and can be rewritten.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] The so-called phase change form optical recording medium using transition between a crystal-amorphous interphase or a crystal-crystal phase is well known as one of the optical-memory media in which record of an electromagnetic wave, especially the information by the exposure of a laser beam, playback, and elimination are possible. Since over-writing by the difficult single beam is especially possible for this phase change form optical recording medium also by optical MAG memory and it is simpler than the optical system by the side of a drive, that researches and developments are active recently. From the advantage that the same optical system can be used especially, the application as a compact disk (CD) whose rewriting is possible which it had in accordance with properties, such as a high reflection factor and high contrast, is expected.
[0003] As a typical example of phase change form material for optical recording, the so-called chalcogen system alloy ingredients, such as germanium-Te, germanium-Te-Sn, germanium-Te-S, germanium-Se-S, germanium-Se-Sb, germanium-As-Se, In-Te, Se-Te, and Se-As, are raised as indicated by USP3530441. Moreover, the proposal of the ingredient which added Au (JP,61-219692,A), Sn, Au (JP,61-270190,A), Pb (JP,62-19490,A), etc. in the germanium-Te system, the proposal of an ingredient (JP,62-73438,A, JP,63-228433,A) which specified the presentation ratio of germanium-Te-Se-Sb and germanium-Te-Sb for the purpose of the improvement in repeatability ability of record/elimination are made for the purpose of the improvement in stability, high-speed crystallization, etc.
[0004] However, the all are originally designed as a rewritable optical disc for code data files, and the present condition is that many properties of most demanded as a rewritable phase change form compact disk are unsatisfying. A reflection factor, contrast, and record sensibility serve as a problem of the utmost importance which solution should solve especially. A reflection factor and contrast were high from these situations, and record of high sensitivity and development of the record ingredient suitable for elimination were desired.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, since it considered as said configuration, it becomes possible to offer a reflection factor and the phase change form optical recording medium which attains the improvement in fast of contrast.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention is made in view of the above situations, and a reflection factor and contrast are high and it aims at offering the phase change form optical recording medium in which rewriting in which the many times repeat of record-elimination is possible is possible by low power.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, according to this invention, in the optical recording medium which performs record elimination using the energy of an electromagnetic wave, the optical recording medium characterized by having the record layer which uses as a principal component the constituent expressed with GaxSe1-X (however, 0.15<=x<=0.8 (atomic ratio)) is offered. Moreover, when said record layer sets the value of kc and an amorphous phase to ka for the value of the crystal layer of the amplitude extinction coefficient which is an optical constant in the above-mentioned configuration according to this invention, the optical recording medium characterized by satisfying kc<=1.1 and the conditions which become ka>=0.7 is offered. According to this invention, it sets in the above-mentioned configuration. On a substrate Furthermore, a lower thermal-resistance protective layer, Optical thickness d2' (=d2xn2) called for from the thickness d2 of optical thickness d1' (=d1xn1) which comes to carry out the laminating of a record layer, an up thermal-resistance protective layer, and the reflecting layer one by one, and is called for from the thickness d1 of said lower thermal-resistance protective layer and a refractive index n1, and said up thermal-resistance protective layer, and a refractive index n2 The optical recording medium characterized by satisfying the following conditions is offered.
500n1<=d1'<=500n1+4700[**]
500n2<=d2'<=500n2+4250[**]
[0007] This invention is explained based on an accompanying drawing below. Drawing 1 shows the example of a configuration of this invention. The lower thermal-resistance protective layer 2, the record layer 3, the up thermal-resistance protective layer 4, and the reflecting layer 5 are formed on the substrate 1. Of course, various deformation, such as not being limited only to this example of a configuration and preparing a environmental protection layer on a reflecting layer 5, and modification are possible for this invention.
[0008] The record layer of this invention is constituted considering the constituent expressed with GaxSe1-X (however, 0.15<=x<=0.8 (atomic ratio)) as a principal component. This record layer can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc. A wet process like sol-gel methods other than vapor growth is also applicable. As thickness of a record layer, it is good to consider [100-1200A] as 200-1000A suitably. When the thickness of a record layer is thinner than 100A, light absorption ability falls remarkably and stops playing a role of a record layer. When thicker than 1300A, it becomes impossible moreover, to take a disk configuration with high reflection factor and contrast. Moreover, as for the energy band gap Eg of a record layer, it is desirable that it is 1.0eV or more. The permeability of light goes up by this energy gap being large, and it becomes possible by using optical interference to make a reflection factor high. Moreover, in a record layer, as for the value kc of the crystal phase of the amplitude extinction coefficient which is an optical constant, it is [1.1 or less] preferably desirable that it is 0.2 or less, and, as for the value ka of an amorphous layer, it is [0.7 or more] preferably desirable that it is 1.0 or more. These conditions are fulfilled, optical interference can be used on suitable conditions by enlarging the

difference of the value of the extinction coefficient of an amorphous phase and a crystal phase, the reflection factor of a crystal phase is large, and it is possible to acquire suitable contrast by lamination with the small reflection factor of an amorphous phase. Moreover, if it is desirable to choose a suitable presentation so that the coordination number near this value, i.e., the coordination number of 2.45**0.6, may be taken and it does in this way in order that amorphous-ization may generally tend to break out with the average coordination number 2.45, it will become easy to make it amorphous and high contrast will be acquired in connection with it.
[0009] The heat-resistant protective layer of the lower part and the upper part can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc. Moreover, the impurity may be included if needed. However, the melting point of a heat-resistant protective layer needs to be higher than the melting point of a record layer.
[0010] As main roles which a lower thermal-resistance protective layer plays, there are effectiveness of securing thermal resistance, and optical effectiveness of using interference and using incident light and the reflected light efficiently. As an ingredient of a lower thermal-resistance protective layer, although the mixture of ZnS and SiO2 etc. can be used, for example, it is not limited to this. Moreover, an up thermal-resistance protective layer performs the role which misses heat to a reflecting layer. As an ingredient of an up thermal-resistance protective layer, although alumimium nitride, the mixture of ZnS and SiO2, etc. can be used, for example, it is not limited to this. If it says from a heat-resistant viewpoint, in a too thin heat-resistant protective layer, superfluous heat will get across to the adjoining substrate and layer. If it is not 50A or more when the layer which the minimum thickness mainly becomes from alumimium nitride or the mixture of ZnS and SiO2 as 500A and an up thermal-resistance protective layer when the layer which mainly consists of mixture of ZnS and SiO2 as a lower thermal-resistance protective layer is used for example, is used, it will become impossible for this reason, to achieve that function.
[0011] Moreover, if it says from an optical viewpoint, the optical conditions that n, then thickness are the same with the period in every lambda/4n will appear the refractive index of lambda and a heat-resistant protective layer in the wavelength of the electromagnetic wave to be used. Therefore, if the optimal minimum thickness is set to d0andn, it is. d0+m- (lambda/4n) (m= 1, 2, 3 ...) .... (I)
It is alike, and it follows and optimum conditions are acquired. However, if a heat-resistant protective layer is too thick, it will lifting-come to be easy of exfoliation of an interface, and a strain. Since it bears the role which misses heat to a reflecting layer, and surplus heat will be accumulated in a record layer, the record elimination property as a disk will deteriorate and it will cause layer separation, mass transfer, etc. if especially an up thermal-resistance protective layer has this too thick, it is not desirable. As for 2 and an up thermal-resistance protective layer, as for a lower thermal-resistance protective layer, 1 serves as [m in a formula (I)] the optimal thickness from these situations. Since the optical recording medium of this invention is related with the compact disk whose rewriting is possible, it should just consider m-(lambda/4n) with a wavelength of 760-840nm. Therefore, when thickness of a lower thermal-resistance protective layer is set to d1 and a refractive index is set to n1, as for the optical thickness d1' (=d1xn1), it is desirable to satisfy the following conditions.
500n1<=d1'<=500n1+4700[**]
Moreover, when thickness of an up thermal-resistance protective layer is set to d2 and a refractive index is set to n2, as for the optical thickness d2' (=d2xn2), it is desirable to satisfy the following conditions.
50n2<=d2'<=50n2+4250[**]
[0012] The ingredient of a substrate is resin, glass, or the ceramics, and a resin substrate is usually suitable for it in respect of a moldability and cost. Although polycarbonate resin, acrylic resin, an epoxy resin, polystyrene resin, acrylonitrile styrene copolymer resin, polyethylene resin, polypropylene pilin resin, silicone system resin, fluorine system resin, ABS plastics, urethane resin, etc. are raised as an example of representation of resin, polycarbonate resin and acrylic resin are desirable in respect of workability, an optical property, etc.
[0013] As a reflecting layer, metallic materials, such as aluminum, Au, and Ag, the alloy of ********,

etc. can be used. Such a reflecting layer can be formed with various vapor growth, for example, vacuum evaporation technique, the sputtering method, a plasma-CVD method, an optical CVD method, the ion plating method, electron beam vacuum deposition, etc.
[0014] Moreover, when the wavelength of a use electromagnetic wave of the optical recording medium of this invention is 760-840mm, as for the Records Department and the non-Records Department, it is desirable [the reflective section of the sheep Records Department] that contrast is 60% or more 70% or more.
[0015] Furthermore, when carrying out record, elimination, and playback using the optical recording medium of this invention, the relative velocity of an optical recording medium and the electromagnetic wave beam spot is equivalent in the less than linear velocity/[s and] at the time of playback of a compact disk, 1.2 or more m/s i.e., 1.4m, or it is desirable that it is the integral multiple.

[Translation done.]

EXAMPLE

[Example] Hereafter, although an example explains this invention concretely, this example does not restrict this invention at all.
[0017] [Example 1] The laminating of ZnS-SiO2 (700A), Ga0.5Se0.5 (870A), alumimium nitride (1100A), and Ag (700) was carried out in the spatter one by one on the polycarbonate substrate with a groove of 120mmphi, ultraviolet-rays hardening resin was applied on it, and the optical disk was produced. The optical constants of Ga0.5Se0.5 were n= 1.755 and k= 0.142 at the Records Department at n= 2.297, k= 0.758, and the non-Records Department. ZnS-SiO two-layer optical constants were n= 2.0 and k**0. Moreover, the heat-resistant protection layer membrane thickness dependency of the reflection factor in the mirror section (part without a group) obtained by this disk configuration, the upper part of contrast, and each lower part was separately searched for by the simulation. The result is shown in drawing 2 and drawing 3 . Up thermal-resistance protection layer membrane thickness and lower thermal-resistance protection layer membrane thickness are set as the above-mentioned value based on the result of drawing 2 and drawing 3 .
[0018] Under above-mentioned disk linear velocity 1.2 m/s and playback light power 1.0mW, the semiconductor laser wavelength of 780nm, and objective lens NA=0.5 conditions, it initialized until the reflection factor was saturated. This obtained 70% of reflection factors. When the record power in an exaggerated write mode, elimination power, CNR, an elimination ratio, and the contrast calculated from the reflection factor of record before and the back were investigated, that sufficient contrast is acquired broke by the power field in which sufficient CNR and a sufficient elimination ratio are obtained.

[Translation done.]

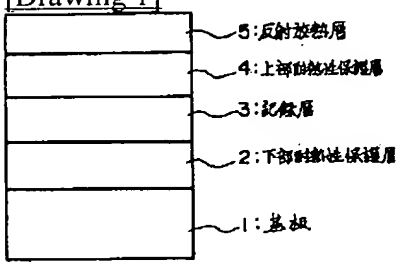
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the example of a configuration of the optical recording medium by this invention in ** type.
[Drawing 2] It is drawing showing a reflection factor and the up thermal-resistance protection layer membrane thickness dependency of contrast.
[Drawing 3] It is drawing showing a reflection factor and the lower thermal-resistance protection layer membrane thickness dependency of contrast.
[Description of Notations]
1 Substrate
2 Lower Thermal-Resistance Protective Layer
3 Record Layer
4 Up Thermal-Resistance Protective Layer
5 Reflecting Layer

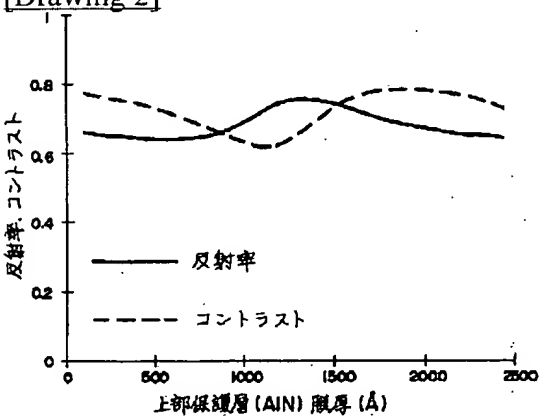
[Translation done.]

DRAWINGS

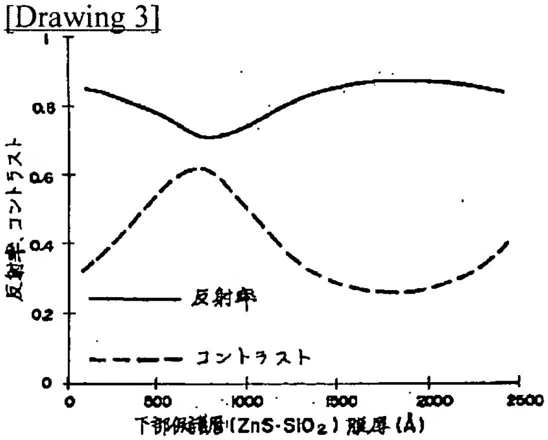
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]